Bias/Efficiency Tradeoff in Preference Elicitation

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Motivation

- Research based on the design of surveys is fundamental to empirical analysis. The bias/efficiency tradeoff in the design of survey questions is arguably the most importation issue in applied research
  - Single question formats
  - Multi-question formats are more efficient (*Hanemann et al., 1991, AJAE*)
  - Additional questions generate bias and numerous mechanisms have been suggested that explain this bias (*Bernheim and Rangel, 2005, NBER; McFadden, 1994, AJAE*)

- Survey methods are used in various fields to elicit preferences and willingness to pay for prospective policy interventions
  - Exxon Valdez oil spill damages (*Carson et al., 2003, ERE*)
  - Unemployment insurance and reservation wages (*Feldstein and Poterba, 1984, JPE; Krueger and Mueller, 2011, WP*)
  - Preferences over inflation and unemployment (*Tella et al., 2001, AER, Shiller, 1997, NBER*)
  - Participation in green electricity programs (*Kotchen and Moore, 2007, JEEM*)
  - Psychology, health and marketing literature

Objectives

- Develop a utility theoretic approach to model individual responses to survey questions
- Catalog the mapping between mechanisms/ancillary conditions and pattern of survey responses by
  - Integrating them into the utility model
  - *Manski's (2007)* "*bottom-up*" approach for specific predictions
- Identify confounding mechanisms and if they are observationally *or* empirically equivalent

General Model w/ Certainty

WTP for a change in quality $q_j^0 \rightarrow q_j^1$

$U_i(y_i - WTP_i, Z_{ij}^1) = U_i(y_i, Z_{ij}^0)$

$Z_{ij} = [X_{ij}, q_j],$ $i = 1,2,..,N,$ $j = 1,2,\dots,J$

$y_i \rightarrow$ Income, $q_j \rightarrow$ Quality of good j

$X_{ij} \rightarrow$ Characteristics of respondents identified by interviewer

Solve for WTP using *simple* and *flexible* functional forms for $U_i(\cdot)$

Functional Forms for Utility

$U_i(\cdot)$	Functional Form	Parameters
Linear	$\alpha_i y_i + \sum_j \beta_{ij} Z_{ij}$	α_i, β_{ij}
Cobb-Douglas	$y_i^{\alpha_i} \prod_j Z_{ij}^{\beta_{ij}}$	α_i, β_{ij}
Translog	$\alpha_i \, ln(y_i) + \sum_j \beta_{ij} ln(Z_{ij}) + \frac{1}{2} \sum_j \sum_k \delta_{ijk} \, ln(Z_{ij}) \, ln(Z_{ik})$	$\alpha_i, \beta_{ij}, \delta_{ijk}$
Nested C.E.S	$\left\{ (1-\alpha_i) \left[\kappa_i q_j^{\xi_i} + (1-\kappa_i) \sum_j \beta_{ij} X_{ij}^{\xi_i} \right]^{\frac{\rho_i}{\xi_i}} + \alpha_i (y_i)^{\rho_i} \right\}^{1/\rho_i}$	$\alpha_i, \beta_{ij}, \kappa_i, \xi_i, \rho_i$

WTP Based on Functional Form of $U_i(\cdot)$

$U_i(\cdot)$	WTP
Linear	$\frac{\beta_{ij}\Delta q_j}{\alpha_i}$
Cobb-Douglas	$y_i - \left[\frac{V_i^0}{\prod_j Z_{ij}^{1\,\beta_{ij}}}\right]^{\frac{1}{\alpha_i}}$
Translog	$y_i - exp\left\{\frac{1}{\alpha_i}\left[U_i^0 - \sum_{ij} lnZ_{ij}^1 - 0.5\sum_j\sum_k \delta_{ijk} lnZ_{ij}^1 lnZ_{ik}^1\right]\right\}$
Nested C.E.S	$y_i - \left[\frac{U_i^{0\rho_i} - (1-\alpha_i)\left[\theta_i q_j^{1\varphi_i} + (1-\theta_i)\sum_j \delta_{ij} X_{ij}^{\varphi_i}\right]^{\frac{\rho_i}{\varphi_i}}}{\alpha_i}\right]^{1/\rho_i}$

Mechanisms in the Utility Model

$WTP_i = f(y_i, X_{ij}, q_j, \tau_{ij}), \qquad \tau_{ij} \rightarrow$ parameters

- Mechanisms effect WTP_i via X_{ij}, q_j or γ_{ij}
- For example anchoring by suggesting plausible values of the good may change the perception of quality
- And there are other mechanisms that impact WTP_i in a similar fashion

Anchoring

Effect of bid on WTP	$\frac{\partial WTP_i(\cdot)}{\partial bid} = \frac{\partial WTP_i(\cdot)}{\partial q_i^1} \times \frac{\partial q_i^1}{\partial bid}$
From WTP functions	$\frac{\partial WTP_i(\cdot)}{\partial q_i^1} > 0$
Bid increasing path	$q_i^1 > q_i^0, \qquad \frac{\partial q_i^1}{\partial bid} < 0$
Bid decreasing path	$q_i^1 < q_i^0, \qquad \frac{\partial q_i^1}{\partial bid} > 0$
Mechanism $\gamma_i \rightarrow$ anchoring parameter *Herriges & Shogren, 1996, JEEM*	$q_i^1 = (1-\gamma_i)q_i^0 + \gamma_i \tilde{q}_i$
$0 \leq \gamma_i \leq 1$ $\gamma_i = 0,$ no anchoring	$WTP_i = f(\gamma_i, q_i^0, \tilde{q}_i, y_i, X_{ij}, \tau_{ij})$

Framing

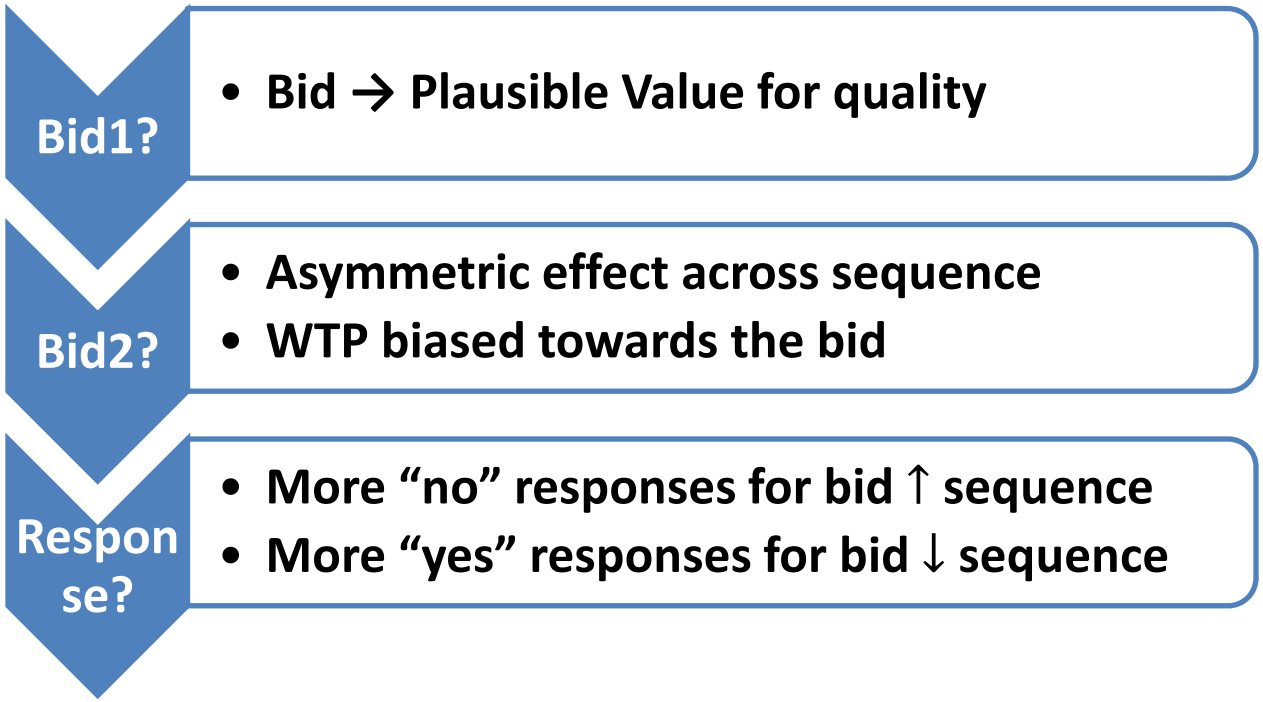
Surplus value of a good *(DeShazo, 2002, JEEM)*	$SV_{ij} = R_{ij} - bid_j$
Loss Aversion	SV_{ij} decreases with bids, WTP_{ij} biased down
Mechanism	$U_i{}^1 = (1 - \pi_i)U_i^0 + \pi_i \widetilde{U}_i^1$ $\widetilde{U}_i^1 \rightarrow$ Utility from hypothetical Scenario
$0 \leq \pi_i \leq 1$ π_i=0, No Framing	$WTP_i = f(\pi_i, q_i^0, \tilde{q}_i^1, y_i, X_{ij}, \tau_{ij})$
Framing only effects the bid increasing path	

Other Mechanisms

Mechanism	Parameter	Suggested Functional Form	Effect on WTP
Disutility *Whitehead, 2002, LE*	D_i	$U_i^1 = U_i^0 + D_i$	Bias Down $D_i < 0$
Preference Instability *Alberini et al., 1997, LE*	β_i	$\beta_{ij} = \beta_i + \epsilon_{ij}$	Indeterminate β_i>0, β_i<0

Observational Equivalence

Anchoring & Weariness
Example – Double Bounded Dichotomous Choice Format



Continued

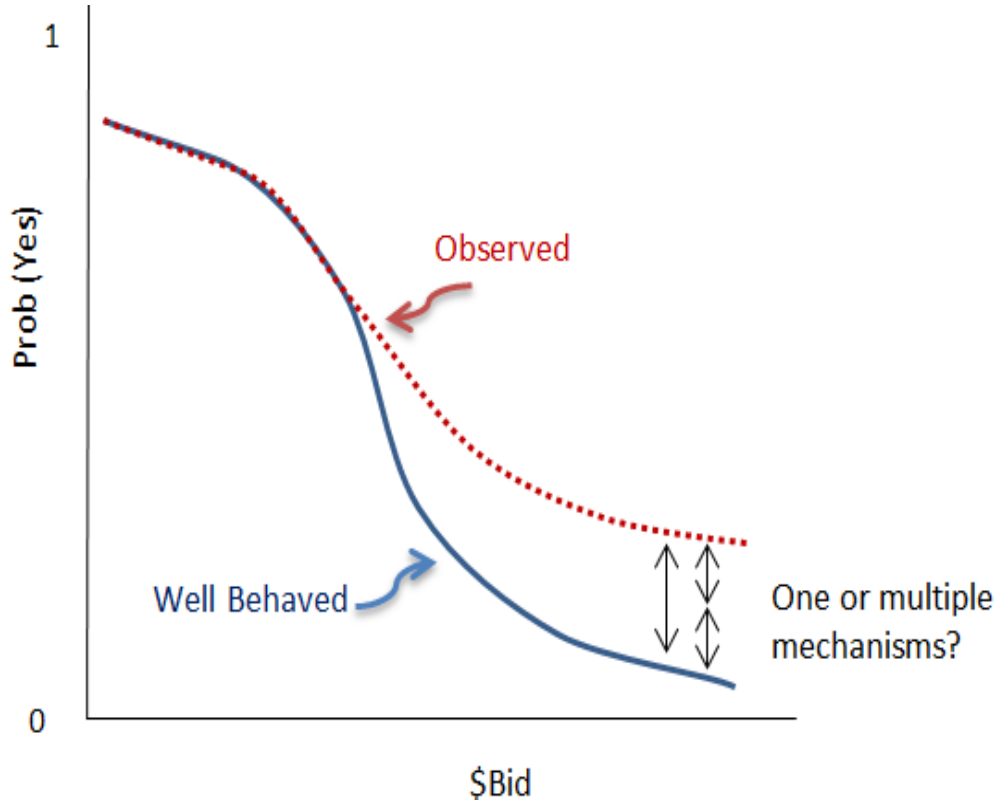
- Framing, Indignation and Wastage
  - Only bid-increasing path
- Disutility and surprise
  - Across paths
- Preference instability
  - Positive shifts for bid-increasing path: Yea-saying/warm-glow/response acquiescence
  - Negative shifts for bid decreasing path: Nay-saying/free riding/strategic bias/quality reduction

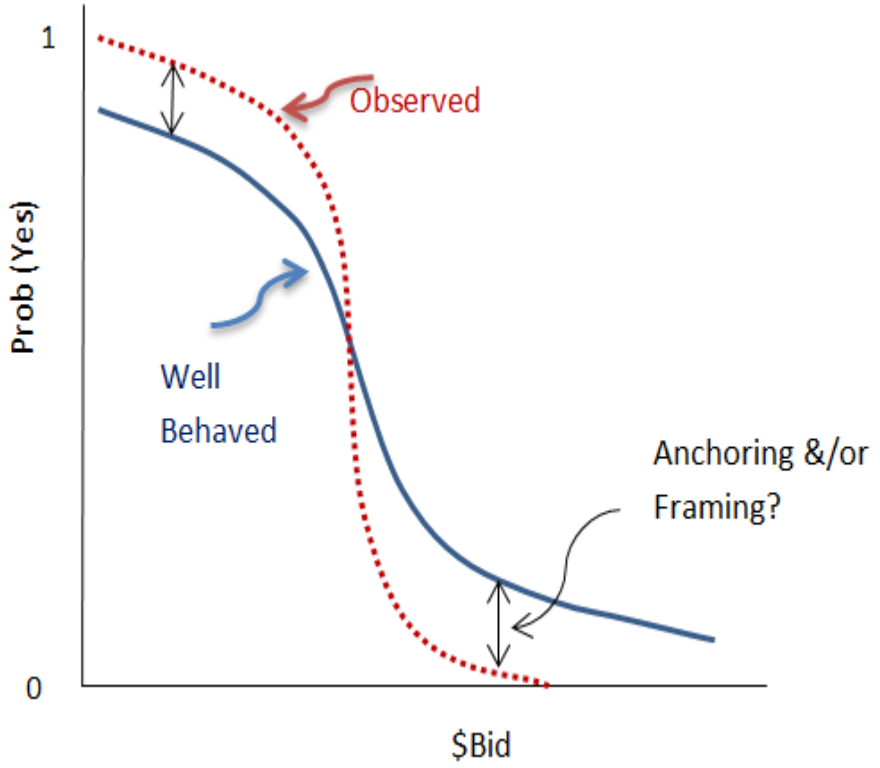
Strategy for Empirical Analysis

- Calibrate distribution of parameters of the utility model using actual survey data.
  - Optimization criteria is to minimize the difference b/w observed responses and predicted responses from our models
- Characterize econometric corrections suggested to remove bias and test if they are effective in reducing bias in our framework
- Use observed/simulated responses to characterize bias due to different mechanisms

Illustration

Well behaved *cdf* vs. observed *cdf* for *WTP*





Conclusion

- Using a utility theoretic approach to model individual responses we show that
  - Anchoring biases WTP towards the bid
  - Framing and disutility bias WTP downwards
  - Preference instability has no clear predictions

- Future empirical strategy
  - Calibrate preference parameters of utility functions
  - Characterize different mechanisms and econometric corrections suggested in the literature